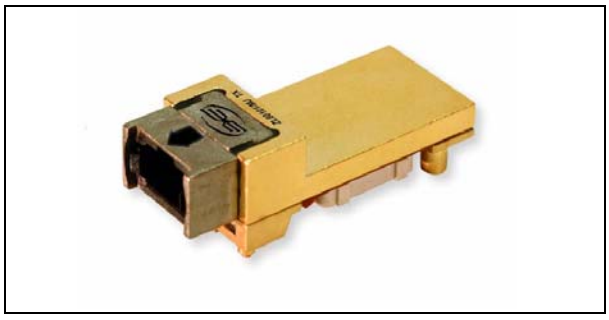
ZL60304

Parallel Fiber Optic Transceiver (4 + 4) x 3.125 Gbps

Data Sheet

January 2006



Ordering Information

ZL60304MJDA Transceiver

Additional heatsink and EMI shield options are available upon request

0°C to +80°C

Features

- Compatible with POP4 MSA usage
- 4 Transmit channels and 4 Receive channels
- Data rate up to 3.125 Gbps per channel
- 850 nm VCSEL array
- Data I/O is CML compatible
- Link reach with 50/125 μm 500 MHz. km fiber, 300-m and 90-m at 2.5 and 3.125-Gbps, respectively
- Channel BER better than 10^{-12}
- Industry standard MPO/MTP™ ribbon fiber connector interface
- Pluggable MegArray® connector
- Laser class 1 M IEC 60825-1:2001 compliant
- Low power consumption, < 1 W
- Power supply 3.3 V

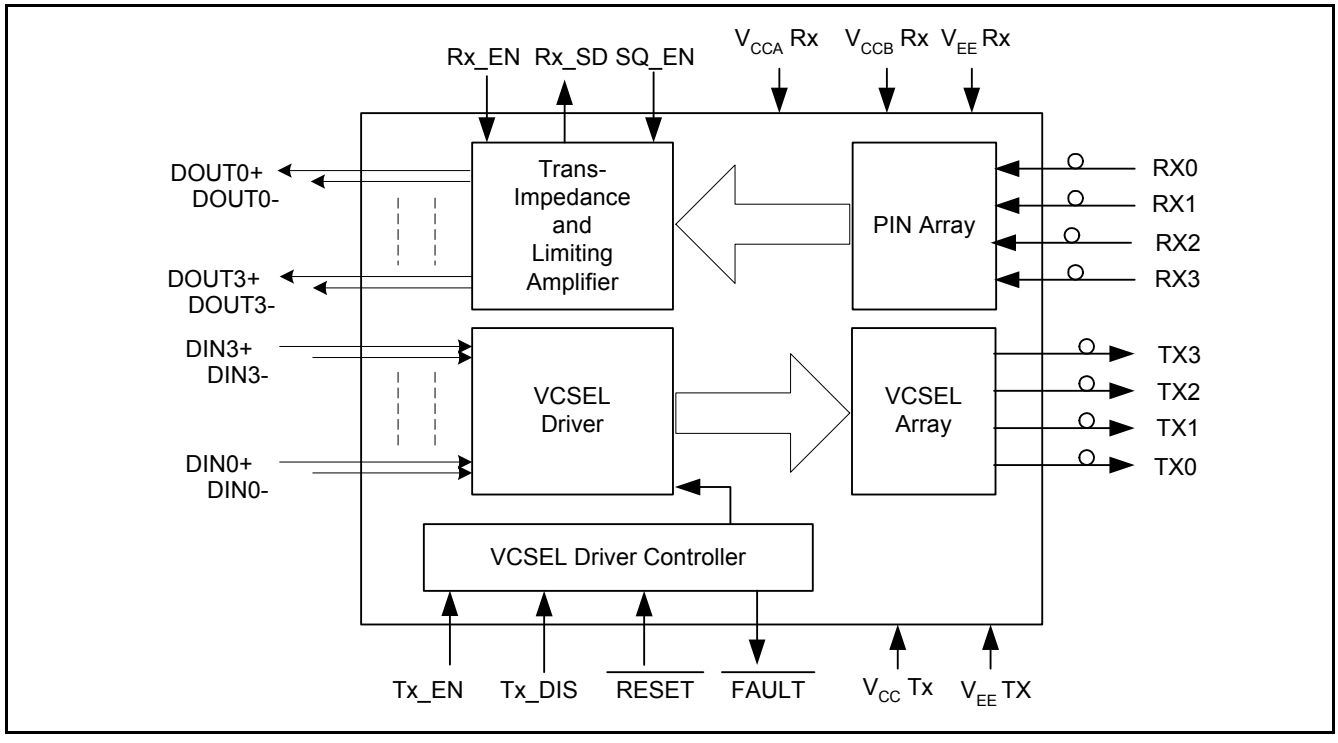


Figure 1 - Transceiver Block Diagram

Applications

- High-speed interconnects within and between switches, routers and transport equipment
- Server-Server Clusters, Super-computing interconnections
- InfiniBand™ 4x-SX compliant
- Fibre Channel connections
- XAUI based interconnections
- Proprietary backplanes
- Interconnects rack-to-rack, shelf-to-shelf, board-to-board, board-to-optical backplane

Description

The ZL60304 is a very high-speed transceiver for parallel fiber applications. This transceiver performs E/O and O/E conversions for data transmission over multimode fiber ribbon.

The ZL60304 provides an effective solution for XAUI transmission of optical fibre, providing advantages in terms of power consumption, edge and board density over competing solutions.

The transmit section converts parallel electrical input signals via a laser driver and a VCSEL array into parallel optical output signals at a wavelength of 850 nm.

The receive section converts parallel optical input signals via a PIN photodiode array and a transimpedance and limiting amplifier, into electrical output signals.

The module is fitted with two pluggable industry-standard connectors. For the electrical interface, a 100 position FCI MegArray® receptacle (FCI PN: 84513-101) is used. For the optical interface, an industry-standard MTP™(MPO) connector is used, which is compliant with IEC 61754-7. This provides ease of assembly on the host board and enables provisioning of bandwidth on demand.

Table of Contents

Absolute Maximum Ratings

Not necessarily applied together. Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied.

Parameter	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-0.3	4.0	V
Differential input voltage amplitude[1]	ΔV		2.4	V
Voltage on any pin	V_{PIN}	-0.3	V_{CC} + 0.3	V
Relative humidity (non-condensing)	M_{OS}	5	95	%
Storage temperature	T_{STG}	-40	100	°C
ESD resistance	V_{ESD}		±1	kV

1. Differential input voltage amplitude are peak to peak values.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Power supply voltage	V_{CC}	3.135	3.465	V
Operating case temperature	T_{CASE}	0	80	°C
Signalling rate (per channel)[1]	f_D	1.0	3.125	Gbps
Link distance[2]	LD	2		m
Data I/O DC blocking capacitors[3]	C_{BLK}	100		nF
Power supply noise[4]	V_{NPS}		200	mV_{p-p}

1. Data patterns are to have maximum run lengths and DC balance shifts no worse than that of a Pseudo Random Bit Sequence of length 2^{23}-1 (PRBS-23). Information on lower bit rates and longer run lengths are available on request.
2. For maximum distance, see Table 4.
3. For AC-coupling, DC blocking capacitors external to the module with a minimum value of 100 nF is recommended.
4. Power supply noise is defined at the supply side of the recommended filter for all V_{CC} supplies over the frequency range of 500 Hz to 3200 MHz with the recommended power supply filter in place.

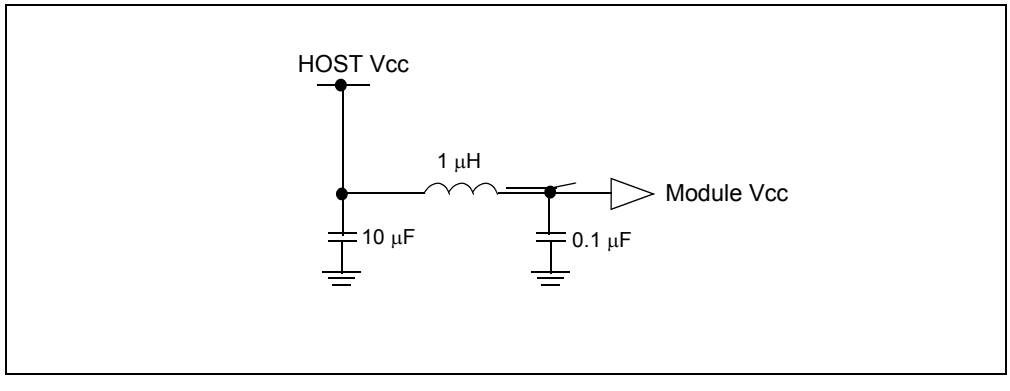


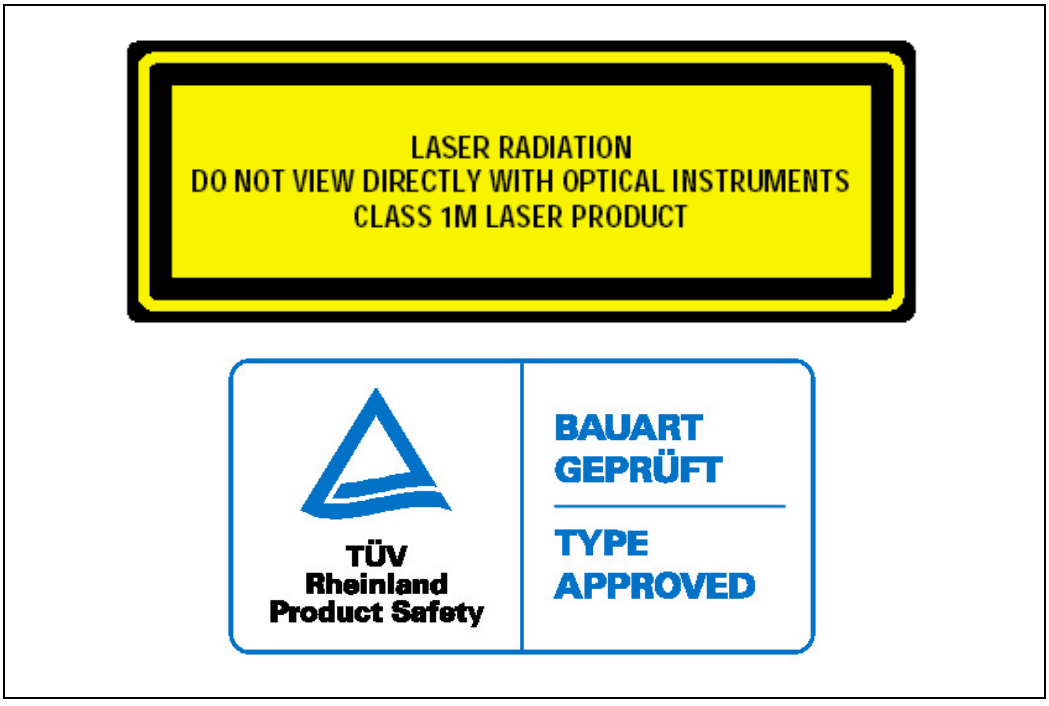
Figure 2 - Recommended Power Supply Filter

Transmitter Specifications

All parameters apply over “Recommended Operating Conditions” on page 4, unless otherwise stated.

Parameter	Symbol	Min.	Max.	Unit
Optical Parameters				
Launch power (50/125 mm MMF)[1]	P_{OUT}	-8	-2	dBm
Extinguished output power	P_{OFF}		-30	dBm
Extinction ratio	ER	6		dB
Optical modulation amplitude[2]	OMA	0.19		mW
Center wavelength	λ_C	830	860	nm
Spectral width[3]	$\Delta\lambda$		0.85	nm_{rms}
Relative intensity noise OMA	$RIN_{12}OMA$		-120	dB/Hz
Optical output rise time (20 - 80%)	t_{RO}		150	ps
Optical output fall time (20 - 80%)	t_{FO}		150	ps
Total jitter contributed (peak to peak)[4]	TJ		0.30	UI
Deterministic jitter contributed (peak to peak)[4, 5]	DJ		0.125	UI
Channel to channel skew[6]	t_{SK}		150	ps
Electrical Parameters				
Power dissipation	P_D		500	mW
Supply current	I_{CC}		150	mA
Differential input voltage amplitude (peak to peak)[7]	ΔV_{IN}	200	1600	mV_{p-p}
Differential input impedance[8]	Z_{IN}	80	120	Ω
Electrical input rise time (20 - 80%)	t_{RE}		140	ps
Electrical input fall time (20 - 80%)	t_{FE}		140	ps

1. The average output optical power is compliant with IEC 60825-1 Amendment 2, Class 1M Accessible Emission Limits.
2. Informative. Corresponds to P_{OUT} = -8 dBm and ER = 6 dB.
3. Spectral width is measured as defined in EIA/TIA-455-127 *Spectral Characterization of Multimode Laser Diodes*.
4. Total jitter is TP2 - TP1 as defined in IEEE 802.3 clause 38.6 (Gigabit Ethernet).
5. Deterministic jitter is informative. Combined random and deterministic jitter should be no higher than stated total jitter.
6. Channel skew is defined for the condition of equal amplitude, zero ps skew signals applied to the transmitter inputs.
7. Differential input voltage is defined as the peak to peak value of the differential voltage between DIN+ and DIN-. Data inputs are CML compatible.
8. Differential input impedance is measured between DIN+ and DIN-.



Classified in accordance with IEC 60825-1/A2:2001, IEC 60825-2: 2000

Class 1M Laser Product

Emitted wavelength: 840 nm

Transmitter Control and Status Signal Requirements

The following table shows the timing relationships of the status and control signals of the transmit section.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Control input voltage high[1]	V_{IH}	$0.6V_{CC}$		$V_{CC}+0.5$	V
Control input voltage low	V_{IL}	-0.5		$0.2V_{CC}$	V
Control pull-up resistor[2]	R_{PU}	20		50	kΩ
Control pull-down resistor[3]	R_{PD1}		10		kΩ
Status output voltage low[4, 5]	V_{OL}			0.5	V
Status pull-down resistor[4]	R_{PD2}		10		kΩ
$\overline{\text{FAULT}}$ assert time	T_{FA}			100	µs
$\overline{\text{FAULT}}$ lasers off	T_{FD}			100	µs
$\overline{\text{RESET}}$ duration	T_{TDD}	10			µs
$\overline{\text{RESET}}$ assert time	T_{OFF}		5	10	µs
$\overline{\text{RESET}}$ de-assert time	T_{ON}			100	ms
Tx_EN assert time	T_{TEN}			1	ms
Tx_EN de-assert time	T_{TD}		5	10	µs
Tx_DIS assert time	T_{TD}		5	10	µs
Tx_DIS de-assert time	T_{TEN}			1	ms

1. Applies to control signals $\overline{\text{RESET}}$, Tx_DIS and Tx_EN.
2. Applies to control signals $\overline{\text{RESET}}$ and Tx_EN. Internal pull-up resistor.
3. Applies to control signal Tx_DIS. Internal pull-down resistor.
4. Applies to status signal $\overline{\text{FAULT}}$. Internal pull-down to V_{EE}.
5. With status output sink current max. 2 mA.

Transmitter Control and Status Timing Diagrams

The following figures show the timing relationships of the status and control signals of the transmit section.

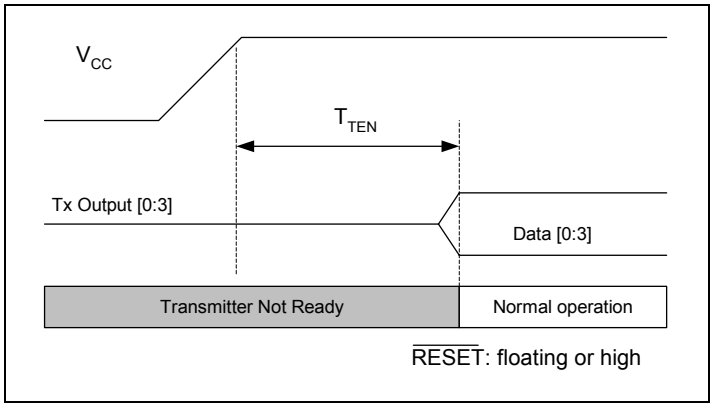


Figure 3 - Transmitter Power-up Sequence

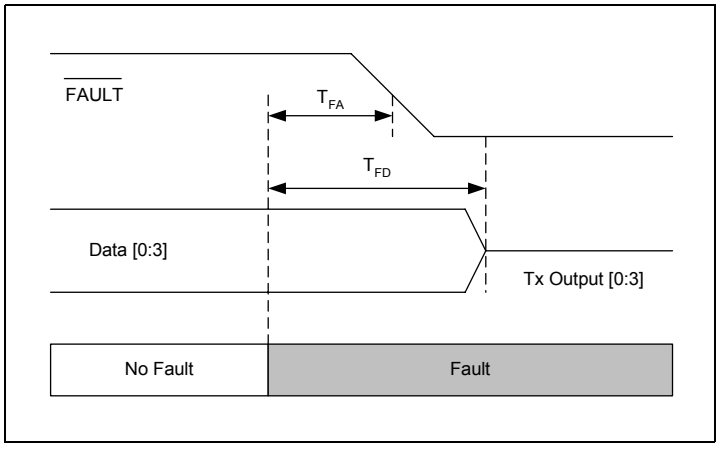


Figure 4 - Transmitter Fault Signal Timing Diagram

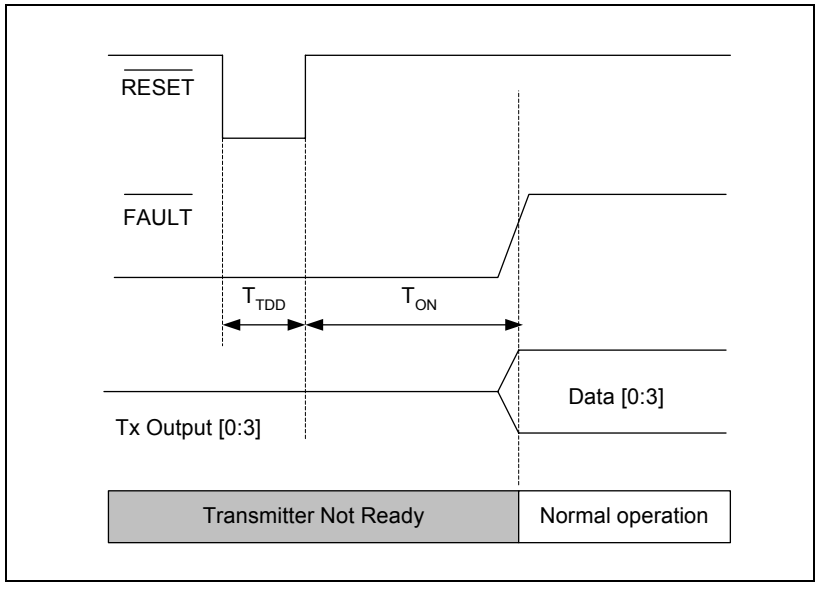


Figure 5 - Transmitter Reset Signal Timing Diagram

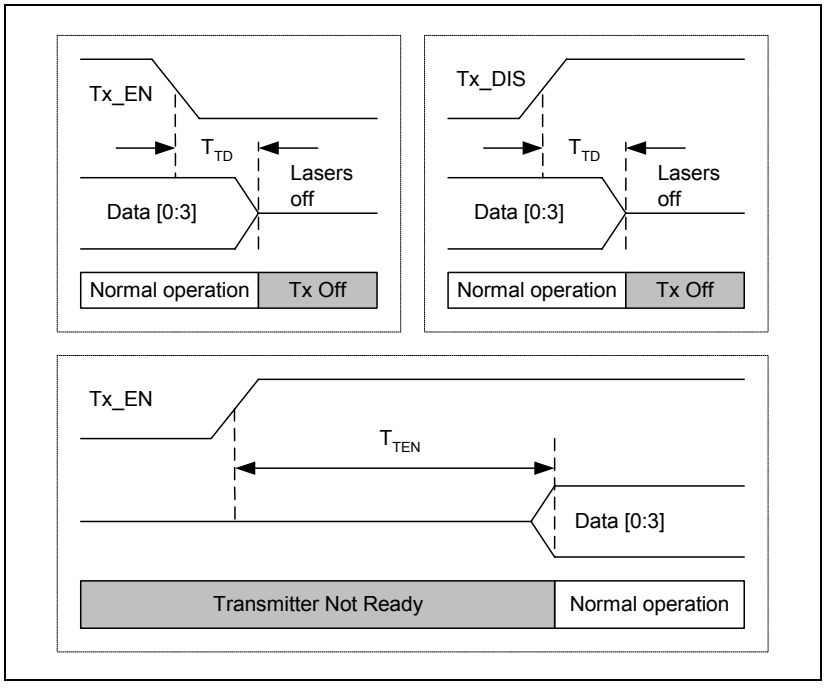


Figure 6 - Transmitter Enable and Disable Timing Diagram

	Tx_DIS High	Tx_DIS Low
Tx_EN High	Transmitter disabled	**Normal operation**
Tx_EN Low	Transmitter disabled	Transmitter disabled

Table 1 - TruthTable for Transmitter Operation (Pre-condition: $\overline{\text{RESET}}$ floating or HIGH)

Receiver Specifications

All parameters apply over “Recommended Operating Conditions” on page 4, unless otherwise stated.

Parameter	Symbol	Min.	Max.	Unit
Optical Parameters				
Unstressed receiver sensitivity[1]	P_{IN}	-14	-2	dBm
Center wavelength	λ_C	830	860	nm
Return loss[2]	RL	12		dB
Stressed receiver sensitivity[3]	P_{SS}		-10.9	dBm
Total link jitter contribution[4]	TJ_L		0.50	UI
Deterministic link jitter contribution[5]	DJ_L		0.20	UI
Channel to channel skew[6]	t_{SK}		150	ps
Signal detect assert	P_{SA}		-16	dBm
Signal detect de-assert	P_{SD}	-31		dBm
Electrical Parameters				
Power dissipation	P_D		500	mW
Supply current	I_{CC}		150	mA
Differential output voltage amplitude (peak to peak)[7]	ΔV_{OUT}	400	800	mV_{p-p}
Output differential load impedance[8]	Z_L	80	120	Ω
Electrical output rise time (20 - 80%)	t_{RE}		150	ps
Electrical output fall time (20 - 80%)	t_{FE}		150	ps

1. Receiver sensitivity is measured using a source that does not degrade the sensitivity measurement, i.e. an ideal source. Receive sensitivity for a channel is measured for a BER of 10^{-12} and worst case extinction ratio. P_{IN} (Min) is measured using a fast rise/fall time source with low RIN and adjacent channel(s) operating with incident power of 6 dB above P_{IN} (Min).
2. Return loss is measured as defined in TIA/EIA-455-107A *Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set*.
3. Based on specified Unstressed receiver sensitivity and Gigabit Ethernet link model,“Link Model Parameters” on page 15.
4. Total jitter is TP4-TP1 values.
5. Deterministic jitter is informative. Combined random and deterministic jitter should be no higher than stated total jitter.
6. Channel skew is defined for the condition of equal amplitude, zero ps skew signals applied to the receiver inputs.
7. Differential output voltage is defined as the peak to peak value of the differential voltage between DOUT+ and DOUT- and measured with a 100 W differential load connected between DOUT+ and DOUT-. Data outputs are CML compatible.
8. See Figure 10.

Receiver Status Signal

The following table shows the timing relationships of the status and control signals of the receive section.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Control input voltage high[1]	V_{IH}	2.0			V
Control input voltage low[1]	V_{IL}			0.9	V
Control input pull-up current[1]	$\lvert I_{IN} \rvert$	10		100	µA
Status output voltage low[2, 3]	V_{OL}			0.4	V
Status output pull-up resistor[2]	R_{PU}		3.25		kΩ
Receiver signal detect assert time	T_{SD}		50	200	µs
Receiver signal detect de-assert time	T_{LOS}		50	200	µs
Receiver enable assert time	T_{RXEN}		33		ms
Receiver enable de-assert time	T_{RXD}		5		µs

1. Applies to control signals Rx_EN, SQ_EN.
2. Applies to status signal Rx_SD. Internal pull-up to V_{CC}.
3. With status output sink current max 2 mA.

Receiver Status Timing Diagrams

The following figures show the timing relationships of the status and control signals of the receive section.

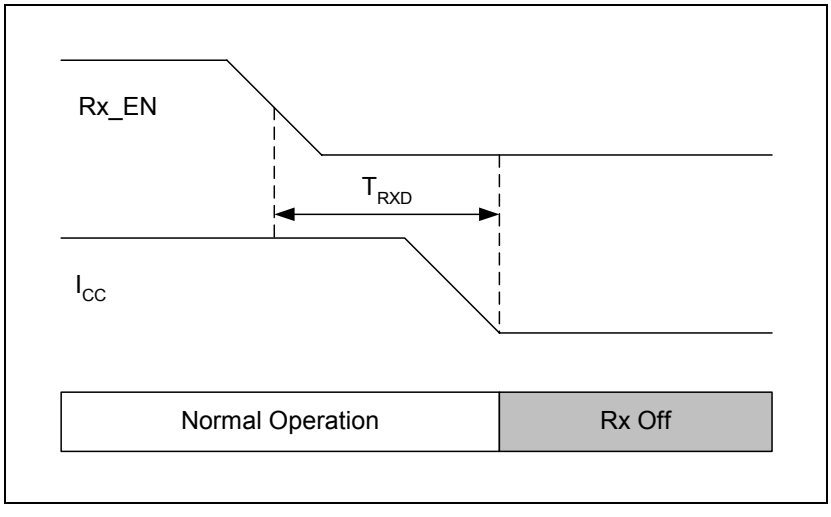


Figure 7 - Receiver Enable Signal Timing Diagram

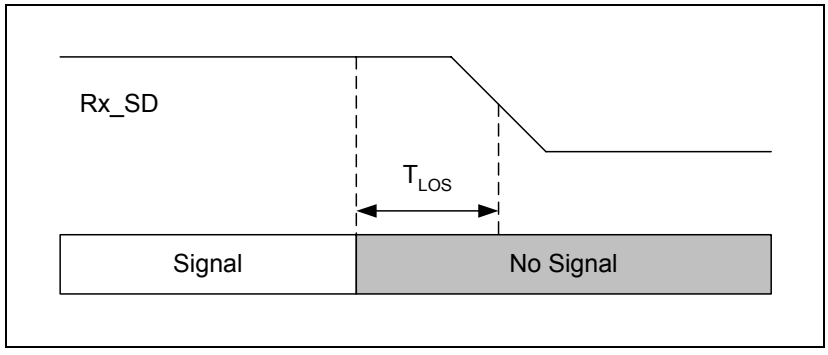


Figure 8 - Receiver Signal Detect Timing Diagram

Transceiver Module Signals

The pluggable parallel optical transceiver uses a 100 position FCI MegArray electrical connector (FCI PN: 84513-101), and an industry standard MTP™(MPO) optical receptacle compliant with IEC 61754-7.

	K	J	H	G	F	E	D	C	B	A
1	DOUT00-	V_{EE} Rx	DOUT03+	V_{EE} Rx	V_{EE} Rx	V_{EE} Tx	V_{EE} Tx	DIN03-	V_{EE} Tx	DIN00+
2	DOUT00+	V_{EE} Rx	DOUT03-	V_{EE} Rx	V_{EE} Rx	V_{EE} Tx	V_{EE} Tx	DIN03+	V_{EE} Tx	DIN00-
3	V_{EE} Rx	V_{EE} Rx	V_{EE} Rx	V_{EE} Rx	V_{EE} Rx	V_{EE} Tx	V_{EE} Tx	V_{EE} Tx	V_{EE} Tx	V_{EE} Tx
4	DOUT01+	V_{EE} Rx	DOUT02-	NIC	NIC	NIC	NIC	DIN02+	V_{EE} Tx	DIN01-
5	DOUT01-	V_{EE} Rx	DOUT02+	NIC	NIC	NIC	NIC	DIN02-	V_{EE} Tx	DIN01+
6	V_{EE} Rx	V_{EE} Rx	V_{EE} Rx	NIC	NIC	NIC	NIC	V_{EE} Tx	V_{EE} Tx	V_{EE} Tx
7	V_{CCB} Rx	V_{CCB} Rx	V_{CCB} Rx	NIC	NIC	NIC	NIC	V_{CC} Tx	V_{CC} Tx	V_{CC} Tx
8	NIC	DNC	DNC	DNC	RX_EN	TX_DIS	TX_EN	DNC	DNC	DNC
9	NIC	DNC	DNC	SD	SQ_EN	$\overline{\text{RESET}}$	$\overline{\text{FAULT}}$	DNC	DNC	DNC
10	V_{CCA} Rx	V_{CCA} Rx	V_{EE} Rx	NIC	NIC	NIC	NIC	V_{EE} Tx	V_{CC} Tx	V_{CC} Tx

Table 2 - Transceiver Pinout Assignments (Top view, toward MPO/MTP™ connector end) (10x10 array, 1.27 mm pitch)

Module front view - MTP key up											
Tx0	Tx1	Tx2	Tx3	–	–	–	–	Rx3	Rx2	Rx1	Rx0
Host printed circuit board											

Table 3 - Transceiver Optical Channel Assignment

Transceiver Pin Description

The transceiver module case is electrically isolated from Transmitter signal common and Receiver signal common. Connection through mounting screw holes or frontplate whichever is applicable. Make the appropriate electrical connection for EMI shield integrity.

Signal Name	Type	Description	Comments
DIN[0:3] +/-	Data input	Transmitter data in, channel 0 to 3	Internal differential termination at 100 Ω.
V_{CC} Tx		Transmitter power supply rail	
V_{EE} Tx		Transmitter signal common. All transmitter voltages are referenced to this potential unless otherwise stated.	Directly connect these pads to the PC board transmitter signal ground plane.
TX_EN	Control input	Transmitter enable. HIGH: normal operation LOW: disable transmitter	Active high, internal pull-up. See Table 1.
TX_DIS	Control input	Transmitter disable. HIGH: disable transmitter LOW: normal operation	Active high, internal pull-down. See Table 1.
$\overline{\text{FAULT}}$	Status output	Transmitter fault. HIGH: normal operation LOW: laser fault detected on at least one channel	When active, all channels are disabled. Clear by reset signal. Internal pull-up.
$\overline{\text{RESET}}$	Control input	Transmitter reset. HIGH: normal operation LOW:reset to clear fault signal	Internal pull-up.
DOUT[0:3] +/-	Data output	Receiver data out, channel 0 to 3.	
V_{CCA} Rx		PIN preamplifier power supply rail.	
V_{CCB} Rx		Receiver quantizer power supply rail.	
V_{EE} Rx		Receiver signal common. All receiver voltages are referenced to this potential unless otherwise stated.	Directly connect these pads to the PC board receiver signal ground plane.
RX_EN	Control input	Receiver enable. HIGH: normal operation LOW: disable receiver	Internal pull-up.
RX_SD	Status output	Receiver signal detect. HIGH: valid optical input on all channels LOW: loss of signal on at least one channel	Internal pull-up.
SQ_EN	Control input	Squelch enable. HIGH: squelch function enabled. Data OUT is squelched on any channels that have loss of signal LOW: squelch function disabled	Internal pull-up.
DNC		Do not connect to any potential, including ground.	
NIC		No internal connection.	

V_{CCA} and V_{CCB} Rx can be connected to the same power supply. However, to insure maximum receiver sensitivity and minimize the impact of noise from the power supply, it is recommended to keep the power supplies separate and to use the recommended power supply filtering network on V_{CCA}Rx, see Figure 2.

Handling Instructions

Cleaning the Optical Interface

A protective connector plug is supplied with each module. This plug should remain in place whenever a fiber cable is not inserted. This will keep the optical port free from dust or other contaminants, which may potentially degrade the optical signal. Before reattaching the connector plug to the module, visually inspect the plug and remove any contamination. If the module's optical port becomes contaminated, it can be cleaned with high-pressure nitrogen (the use of fluids, or physical contact, is not advised due to potential for damage).

Before a fiber cable connector is attached to the module, it is recommended to clean the fiber cable connector using an optical connector cleaner, or according to the cable manufacturer's instructions. It is also recommended to clean the optical port of the module with high-pressure nitrogen.

Connectors

For optimum performance, it is recommended that the number of insertions is limited to 50 for the electrical MegArray connector and 200 for the optical MPO/MTP connector.

ESD Handling

When handling the modules, precautions for ESD sensitive devices should be taken. These include use of ESD protected work areas with wrist straps, controlled work-benches, floors etc.

Link Reach

The following table lists the minimum reach distance of the pluggable parallel fiber optic transceiver for different multi-mode fiber (MMF) types and bandwidths based on the Gigabit Ethernet link model version 2.3.5. Each case allows for a maximum of 2 dB per channel connection loss for patch cables and other connectors and assumes worst case on all input parameters.

Fiber Type [core / cladding μm]	**Modal Bandwidth @ 850 nm** [MHz*km]	**Reach Distance @ 2.5 Gbps** [m]	**Reach Distance @ 2.7 Gbps** [m]	**Reach Distance @ 3.125 Gbps** [m]
50/125 MMF	400	260	230	80
50/125 MMF	500	300	270	90

Table 4 - Link Reach for Different Fiber Types and Data Rates

Longer operating distance than the range specified here can be achieved using transmitters, receivers and / or cables meeting specification but performing better than worst case.

Link Model Parameters

The link reaches above have been calculated using the following link model parameters and Gigabit Ethernet link model version 2.3.5 (filename: 5pmd047.xls).

Parameter	**Symbol**	**Value**	**Unit**
Mode partition noise k-factor	k	0.3	
Modal noise	MN	0.3	dB
Dispersion slope parameter	S_O	0.11	ps/nm^2*km
Wavelength of zero dispersion	U_O	1320	nm
Attenuation coefficient at 850 nm	α_{dB}	3.5	dB/km
Conversion factor	C1	480	ns.MHz
Q-factor [BER 10^{-12}]	Q	7.04	
TP4 eye opening		0.3	UI
DCD allocation at TP3	DCD DJ	0.08	UI
RMS baseline wander S.D.	σ_{BLW}	0.025	
RIN coefficient	k_{RIN}	0.70	
Conversion factor	c_rx	329	ns.MHz

Electrical Interface - Application Examples

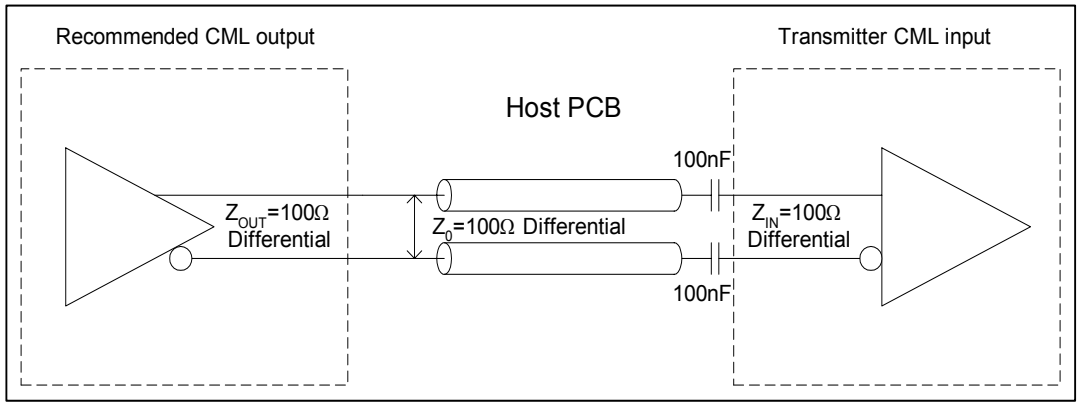


Figure 9 - Recommended Differential CML Input Interface

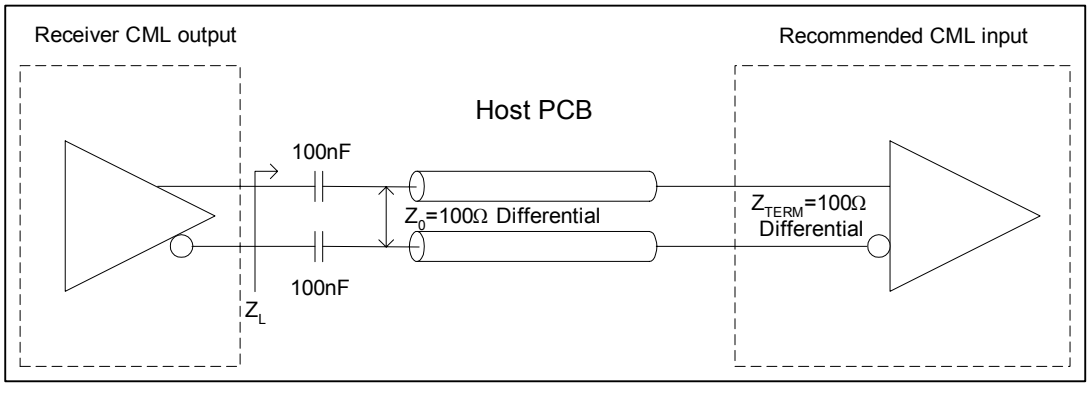


Figure 10 - Recommended Differential CML Output Interface

Trademarks

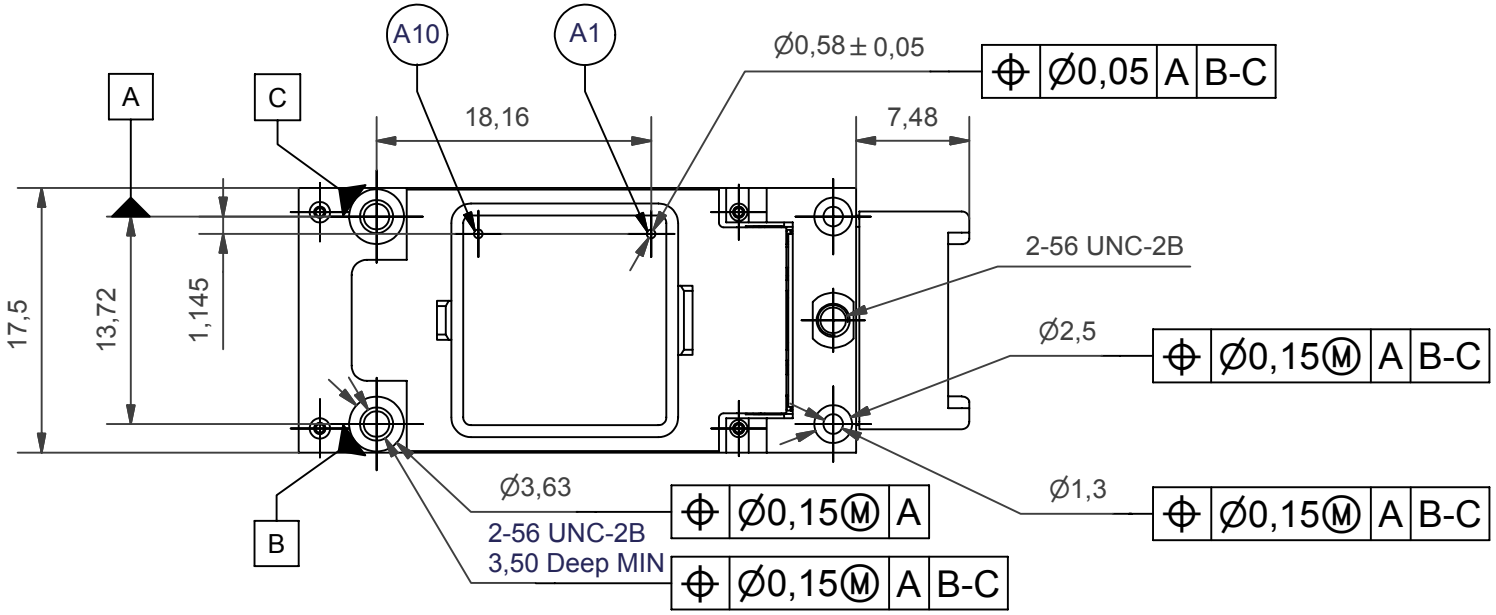
Infiniband is a registered trademark of the InfiniBand Trade Association.

MTP is a registered trademark of US Conec Ltd.

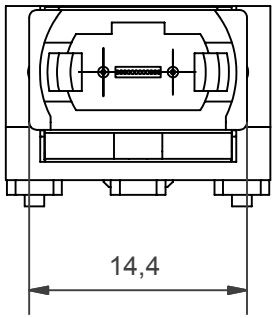
The MegArray is a registered trademark of FCI.

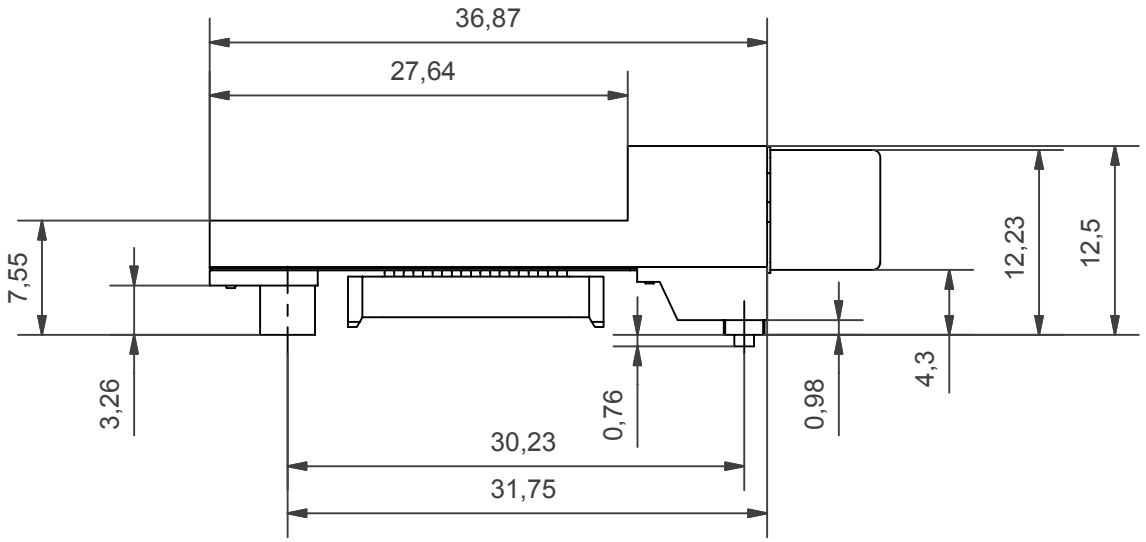
NOTES:-

1. All dimensions in mm.
2. Tolerancing per ASME Y14.5M-1994.



FRONT VIEW (2 : 1)





Projection Method

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DATE	12-JUN-03	24-JAN-04	24-JAN-05	
APPRD.	TD/BE	MD/MA	MD/MA	

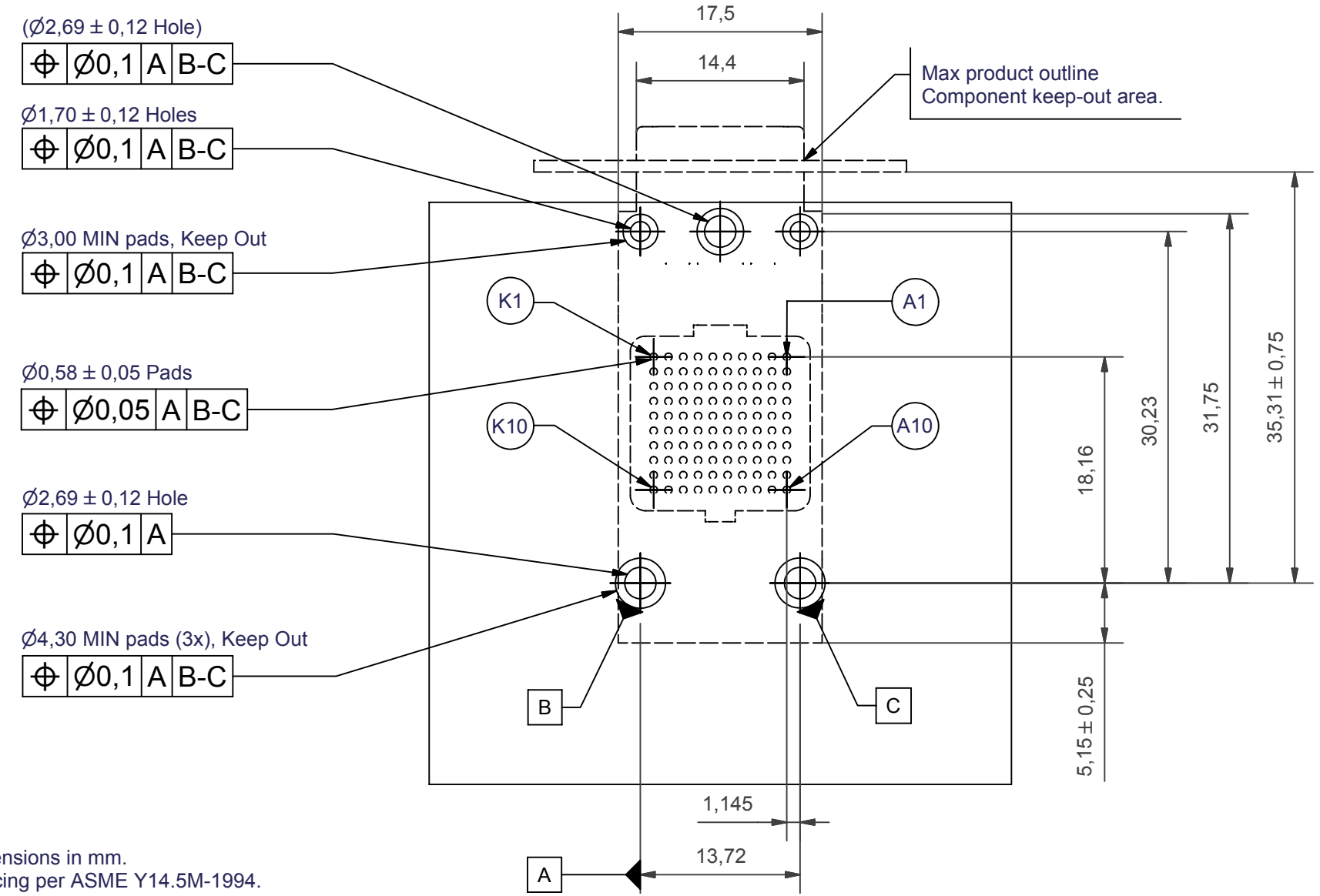
ZARLINK SEMICONDUCTOR

Previous package codes

Package code MJ

Drawing type
Package Drawing - Module Layout

Title JS004296



NOTES:-

1. All dimensions in mm.
2. Tolerancing per ASME Y14.5M-1994.

Projection Method

ISSUE	1	2	3	
ACN	JS004296R1A	JS004296 rev.2	JS004296 rev.3	
DATE	12-JUN-03	24-JAN-05	14-FEB-05	
APPRD.	TD/BE	MD/MA	MD/MA	

ZARLINK SEMICONDUCTOR

Previous package codes

Package code MJ

Drawing type
Package Drawing,
Host Circuit Board Footprint Layout

Title JS004296

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